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SYSTEM FOR HEATING PROCESS WATER AND FOR KILLING LEGIONELLA IN THIS PROCESS WATER

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SYSTEM FOR HEATING PROCESS WATER AND FOR KILLING LEGIONELLA IN THIS PROCESS WATER

[Anlage zum Erwärmen von Brauchwasser und zum Abtöten von Legionellen in diesem Brauchwasser]

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The invention relates to a system for heating process water and for killing legionella in this process water with a cold-water supply line to a first heat exchanger for preheating the supplied cold water and for cooling the process water fed via a process-water waste line from a disinfecting-water circuit, which is heated to a disinfecting temperature and which is composed of a water heater, a load pump, a process-water storage device, and a buffer, wherein, in the advancing direction of the process water, the buffer is connected via the process-water waste line to the first heat exchanger and from here with the process-water distributing line to the tap points and a circulating line with circulating pumps. /2*

* [Numbers in right margin indicate pagination of the original text.]

A system of this type is known from Figures 4, 4a, and also 8 to 10 of DE-PS 38 40 516. Although the system described therein fulfills its function for killing legionella and also distinguishes itself through an energy-efficient operation, in the meantime it has been determined through extensive tests that legionella cannot be prevented in the circulating water circuit. This circulating water circuit is composed essentially of the process water distributing line to the tap points, a circulating pump, and a process-water collection line. According to the result of these tests, the cause for the formation of legionella despite the feeding of already disinfected water to this circulating water circuit lies essentially in that legionella is transferred into the circulating water circuit already with the first filling of the system with cold water, from which the legionella cannot be eliminated with the typical means of thermal disinfection. This lies in the fact that the thermal disinfection described in DE-PS 38 40 516 in column 1 in the third paragraph cannot be achieved with the conventional means and methods with sufficient reliability by a step-wise adjustment of the temperature in the process-water distributing line to 70° in practice for large systems of the mentioned type in hospitals, retirement homes, hotels, and barracks after their first filling or for an interrupt in operation.

Starting with this state of the art, the invention is based on the problem of creating a system of the class named above, with which the legionella led into the circulating water circuit can be either considerably reduced or even killed in a more energy-efficient operation.

This problem is solved in connection with the class named above according to a first alternative in that the process-water distributing line is connected via a process-water collection line, via a non-return valve, a water-quantity limiter, the cold-water supply line, and also via an access line to the loading pump via the water heater and the buffer to form a complete circuit. Obviously, the disinfecting temperature in the disinfecting water circuit is kept constant and permanent, whereby this high temperature range and also the associated lime deposits remain limited to a spatially very limited region of the overall system. Furthermore, despite the connection of the disinfecting water circuit to the circulating water circuit into a complete circuit, an energy-efficient operation is maintained. Therefore, the legionella present in the circulating water circuit due to the first filling or due to an interruption in operation can be transferred into the disinfecting water circuit and killed there when the tap is inactive. Thus, the concentration of legionella in the circulating water circuit is reduced considerably. If the entire system has a long time of tap inactivity, in this way all of the circulating water can be fed several times through the disinfecting water circuit and in this way eventually a complete elimination of legionella can be achieved. Here, the first solution alternative named above has the advantage of requiring only one heat exchanger.

According to a second alternative, in connection with the class named above, the problem forming the basis of the invention is solved in that the first heat exchanger is connected in a known

way via a first-run connection line and a second heat exchanger to the process-water distributing line at the tap points via a process-water collection line, via a non-return valve, a water-quantity limiter, and also via an access line to the loading pump via the heat exchanger and the buffer into a complete circuit. Due to the second heat exchanger, this solution alternative has several different regulating possibilities.

Both solution alternatives have in common that the legionella-carrying circulating water is led from the process-water collection line via a non-return valve and a water-quantity limiter in the direction towards the disinfecting water circuit. The water-quantity limiter has the effect that only so much circulating water is led from the process-water collection line to the disinfecting water circuit, so that a reliable and constant disinfecting temperature is guaranteed through the loading pump and a partial quantity of the loading pump is maintained to the disinfecting water circuit and only the excess in the process-water storage device and/or the buffer can transfer a certain quantity of enthalpy to be controlled in the disinfected water of the disinfecting water circuit to the /3
legionella-carrying water from the circulating water circuit and thus can be reintroduced into the disinfecting process in a energy-efficient way. The non-return valve provides a single direction of flow in the entire circuit.

For tap inactivity, the output of the loading pump above the output of the circulating pump draws the storage volume found in the process-water storage device via a connection line and heats it to the disinfecting temperature back in the disinfecting water circuit. In this way, the output of the circulating pump (liters per minute) should equal a maximum of 50% of the output of the loading pump. Namely, if the output of the circulating pump were to be greater than 50% up to a maximum of 100% of the loading pump, then only a small quantity of the loading pump or the disinfecting water circuit could be led continuously into the process water storage device, wherein the remaining quantity would flow directly into the distributing circuit. Because, according to relevant publications, the microbial growth of legionella requires large periods of time and doubling can occur only in two to three hours, the legionella is reduced considerably both from the circulating water circuit and also from the cold-water network by means of disinfection and is completely killed for longer tap inactivity through the described suctioning of the process water through the excess output of the loading pump relative to the circulating pump.

To minimize the container expense and thus also the heat loss due to dissipation, it is especially advantageous in terms of energy efficiency that the process water storage device is formed in a known way the same as a reaction container in whose top part there is a reaction volume as a buffer and in whose bottom part there is the storage volume. In this way, the buffer found in the process water storage device can be enlarged by one or more preceding buffers and/or the storage volume can be enlarged by one or more hot-water storage devices downstream in the direction of flow of the loading pump.

For achieving a reliable disinfecting water circuit operation and also for including the circulating water circuit, which is beneficial to energy efficiency, in the disinfecting water circuit, several loading pumps are allocated either to a common water heater in parallel connection or each to a single water heater. Furthermore, in the disinfecting water circuit, several parallel loading pumps are advantageously allocated to one or more reaction container(s) connected one behind the other or they each act on separate reaction containers connected in parallel to each other.

According to an especially advantageous refinement of the invention, in the cold-water supply line to the first heat exchanger, there is a cold-water quantity regulating valve, whose second path is connected via an intermediate line to the first heat exchanger and from here via a connection line like the third path to the access line to the process-water storage device. In this way, the cold-water quantity regulating valve can be advantageously regulated by a temperature sensor arranged in the process-water distributing line at the tap points. Through the cold-water quantity regulating valve in the cold-water supply line, it is guaranteed for taps that water flows in with selectable, constant temperature via the process-water distributing line into the circulating water circuit, without having to increase the water temperature behind the hot-water heater in the disinfecting water circuit. In this way, the lowest permissible temperature in the disinfecting water circuit directly behind the water heater is defined by the selected reaction volume of the buffer and by the microbe concentration to be expected in the water to be heated. According to previous experience, a disinfecting temperature of +65°C requires a reaction time of at least 15 min and a disinfecting temperature of 70°C requires a reaction time of at least 4 min to be able to kill all of the legionella in the disinfecting water circuit.

To prevent overloading the process-water storage device during tapping, before the cold-water quantity regulating valve in the cold-water supply line in the direction of flow there is a safety control valve, which can be throttled or closed by a temperature sensor in the reaction container in the vicinity of the process-water output line if the temperature of the storage volume in the reaction container falls below a set minimum temperature. Through this measure, cold water that has not been disinfected cannot be "shot" directly into the process-water output line and in this way reach the circulating water circuit.

For large systems with associated large circulating capacities in the circulating water circuit, it is advantageous that in the direction of flow before the water-quantity limiter and the non-return valve in the process-water collection line there is a circulating water distributing valve, whose third path is connected hydromechanically either via a first bypass line to the process-water distributing line at the tap points or via a second bypass line and a first circulating water quantity /4
regulating valve to a heating coil, which is arranged in the boundary between the reaction volume and storage volume in the reaction container. By means of this circulating water distributing valve, it is guaranteed that only the absolutely necessary water quantity of disinfected water with a

selectable constant temperature can flow via the process-water distributing line into the circulating water circuit.

In this way, for reducing the load on the disinfecting water circuit, the circulating water distributing valve is regulated either as a function of the disinfecting temperature in the disinfecting water circuit by a temperature sensor arranged between the loading pump and storage volume or as a function of the time by means of a clock, such that the total circulating water quantity or a part of this water quantity is released from the circulating water circuit to the first heat exchanger and the remaining total or partial circulating water quantity can be transported via the first bypass line into the process-water distributing line at the tap points or via the second bypass line in the heating coil for renewed heating.

The first circulating water quantity regulating valve in the second bypass line can be regulated advantageously according to a temperature sensor in the process-water output line from the reaction container.

The "process-water priority switch" previously described for hot-water supply systems in residential buildings requires, in an advantageous refinement of the invention, the loading pump, the circulating pump, and a heating medium pump to be connected or regulated each depending on temperature sensors in the process water output line, in the process water storage device, in the connecting line, and in a heating medium line of the water heater. For large systems and high demands on the temperature consistency in the circulating water circuit, in an advantageous way for the first solution alternative in the process-water collection line in the direction of flow before the second heat exchanger there is a second circulating water quantity regulating valve, whose first path is connected to the water quantity limiter, whose second path is connected to the second heat exchanger, and whose third path is connected to the return connecting line. In this way, this second circulating water quantity regulating valve is advantageously regulated by a temperature sensor in the process water distributing line at the tap points.

In the scope of the invention, the first heat exchanger can be charged by the process-water output line and the cold-water supply line either in the same flow or a counter flow. The selection of the flow direction depends, among other things, on the required standard, the requirements on the consistency of the output temperature, and also on the type of first or second solution alternative. Also, for forming several independent circulating water circuits, several process-water distributing lines and process-water collection liens each with separate tap points and circulating pumps can be connected in parallel. In this case, the circulating water circuits are operated with different forward and return temperatures using additional heaters.

For forming a compact device with reference to the disinfecting water circuit, the first and second heat exchangers can be integrated themselves or in common with the water heater or heaters and loading pumps, as well as with one or more reaction containers of the disinfecting

circuit, into a compact device. Such a compact device not only has a very space-saving configuration, but it can also be inserted without a problem at a later time into already existing systems for process-water disinfection without special expert knowledge of the assembly personnel.

Another considerable simplification is achieved in that the first and/or the second heat exchanger is assembled from a total of three compactly integrated sub-heat exchangers, of which the first heat exchanger is connected at its input to the process-water output line and at its output to the process-water distributing line, the second heat exchanger is connected at its input to the cold-water supply line and at its output to the access line to the process-water storage device, and the third heat exchanger is connected with its input to the process-water collection line and with its output to the access line to the process-water storage device without internal connection lines.

According to an especially advantageous refinement of the invention, for large systems, the process water distributing line forms a distributing circuit, from which one or more stub lines branch off to secondary distributing devices, with the circulating pump and the process-water collection line.

According to a first embodiment, at least one first stub line branches off from the distributing circuit, wherein this first stub line provided with electrical companion heaters leads to individual removal points. Due to the individually adjustable companion heaters, temperatures preventing the multiplication of legionella and also individual tap temperatures at the tap points are possible without negatively affecting the circulating water circuit and also the disinfecting water circuit.

For a second embodiment, at least one second stub line leads from the distributing circuit /5
to a secondary distributing device composed of a secondary distributing line at tap points, a circulating pump, a UV emitter, and a third heat exchanger with a high circulating output, whose circulating heat losses can be equalized by the third heat exchanger and also be a hot-water distributing valve from the distributing circuit.

According to a third embodiment, one or more stub lines from the distributing circuit lead to one or more closed secondary distributing circuits provided with tap points and composed of a circulating pump, a circulating line, and a fourth heat exchanger, with high circulating output, which is connected via the fourth heat exchanger to a secondary disinfecting circuit composed of a water heater and a reaction container, in which the circulating pump is the same as the loading pump.

Several embodiments of the invention are shown in the drawings. Shown are:

Figure 1, a first embodiment according to the 1st solution alternative with a first heat exchanger and a cold-water quantity regulating valve in the cold-water supply line,

Figure 2, an embodiment according to Figure 1 with a first heat exchanger composed of three sub-heat exchangers in the total circuit,

Figure 3, a system according to the 1st solution alternative with a first heat exchanger, a cold-water quantity regulating valve, and a circulating water distributing valve in the circulating water circuit,

Figure 4, a system according to the embodiment of Figure 3, but with a connection of the circulating water distributing valve via a second bypass line and a circulating water quantity regulating valve with a heating coil in the reaction container,

Figure 5, a system similar to Figure 4 but with two parallel water heaters and loading pumps in the disinfecting water circuit, several successive process-water storage devices, an upstream buffer, and several parallel circulating water circuits with separate circulating pumps,

Figure 6, an embodiment similar to Figure 5 but with two parallel reaction containers each with a circulating water quantity regulating valve and with separate water heaters in the disinfecting water circuit,

Figure 7, an embodiment similar to Figure 5 but with a distributing circuit from which two stub lines lead to secondary closed distributing devices with electrical companion heaters on one side and with a UV emitter on the other side,

Figure 8, an embodiment similar to Figure 7, but with three stub lines branching off from a distributing circuit to three different, closed, secondary distributing devices,

Figure 9, a first embodiment according to the 2nd solution alternative with a first heat exchanger and a second heat exchanger connected to the first via a forward connecting line between the disinfecting water circuit and the circulating water circuit,

Figure 10, an embodiment similar to Figure 9 but with a cold-water quantity regulating valve before the first heat exchanger and a circulating water quantity regulating valve before the second heat exchanger,

Figure 11, an embodiment similar to Figure 10 but with a differently arranged cold-water quantity regulating valve and circulating-water quantity regulating valve and also an additional circulating valve water distributing valve in the process water collection line,

Figure 12, an embodiment similar to Figure 11, however, without the circulating water distributing valve but with a heating medium pump in the heating medium circuit of the water heater and also various additional temperature sensors,

Figure 13, an embodiment similar to Figure 11 but with a connection of the circulating water distributing valve via a second bypass line to two parallel process-water storage devices with heating coils and a subsequent process-water storage device, as well as several parallel circulating water circuits,

Figure 14, an embodiment similar to Figure 11 but with a compactly assembled first and second heat exchanger for a total of three sub-heat exchangers,

Figure 15, an embodiment similar to Figure 14, however, without the circulating water distributing valve but with a heating medium pump in the heating medium circuit of the water heater, and

Figure 16, an embodiment similar to Figure 14 but with a first bypass line from the circulating water distributing valve to the process-water distributing line, two parallel water heaters and loading pumps arranged in the disinfecting water circuit, an upstream buffer, and two subsequent process-water storage devices.

Each of the systems described below has a disinfecting water circuit 1 and a circulating /6 water circuit 2. The disinfecting water circuit 1 is formed, in principle, by a water heater 3, a loading pump 4, a process-water storage device 5, and a buffer 6, which is arranged in the present case in a known way in the top part of the process-water storage device 5, which in this case is formed in the same way as the reaction container and in whose bottom part the storage volume 7 is located. Another storage device 8 is connected downstream in series to this process-water storage device 5, which below is also called reaction container 5 with buffer 6 and storage volume 7.

In the forward direction of the process water according to the drawn arrows, which, however, are not labeled for the sake of clarity, the buffer 6 is connected via the process-water output line 9 to the first heat exchanger 10 and this is connected via the process-water distributing line 11 at the tap point 12 and a circulating line 13 to the circulating pump 14, via a process-water collection line 15, a non-return valve 16, and a water-quantity limiter 17 to the cold-water supply line 18. In the cold-water supply line 18, in addition to a safety control valve 19, there is a cold-water quantity regulating valve 20. The cold-water quantity regulating valve 20 is formed as a three-way valve, whose first path 20a is connected to the supply flow of the cold-water supply line 18, whose second path 20b is connected via an intermediate line 21 to the first heat exchanger 10 and from this exchanger 10 via a connecting line 22 as the third path 20c to the access line 23 to the process-water storage device 5. In this way, the circulating water circuit 2 is connected to the disinfecting water circuit 1 into a complete circuit 1, 2.

The cold-water quantity regulating valve 20 can be regulated by a temperature sensor 24, which is arranged in the process-water distributing line 11 at the tap points 12. The safety control valve 19 in the cold-water supply line 18 is regulated by a temperature sensor 25, which is arranged in the reaction container 5 in the vicinity of the process-water output line 9 and which throttles or closes the safety control valve 19 if the temperature in the disinfecting circuit 1 falls below the required minimum temperature of the storage volume 7 in the reaction container 5.

The water heater 3 in the disinfecting water circuit 1 is fed from a heating medium line 26 with a heating medium regulating valve 27, which is regulated by a sensor 28 in the connecting line 29 between the water heater 3 and the process-water storage device 5.

According to an advantageous refinement of the invention, for tap inactivity, the output of the loading pump 4 above the output of the circulating pump 14 draws the storage voltage 7 in the process-water storage device 5 via a connecting line 30 and also the process water from the circulating water circuit 2 via the access line 23 and heats it back to the required disinfecting temperature in the disinfecting water circuit 1. Therefore, the microbe concentration in the circulating water circuit 2 is considerably reduced during tap inactivity and is also completely killed under some circumstances during longer tapping intervals.

In all of the figures described below, matching parts are also labeled with identical reference symbols.

According to Figure 2, the first heat exchanger 10 is composed of a total of three compactly assembled sub-heat exchangers 10a, 10b, and 10c, of which the first 10a is connected at its input to the process-water output line 9 and at its output to the process-water distributing line 11, the second 10b is connected at its input to the cold-water supply line 18 and at its output to the access line 23 to the process-water storage device 5, and the third sub-heat exchanger 10c is connected with its input and output to the access line 23 to the process-water storage device 5. Here, the arrows designate the flow directions. The heating medium regulating valve 27 in the heating medium line 26 is regulated in the present case not only by the sensor 28 in the connecting line 29, but also by another sensor 31, which is arranged in the process-water distributing line 11. The cold-water quantity regulating valve 20 from Figure 1 is unnecessary in the embodiment of Figure 2 due to the flow direction in the three sub-heat exchangers 10a, 10b, 10c, the additional sensor 31, and the associated regulating flexibility.

In addition, in all of the figures, between the loading pump 4 and the water heater 3 there is a water quantity regulating valve 32, which, in agreement with the water quantity limiter 17 in the process-water collection line 15, ensures that the loading pump 4 circulates a circulating quantity in the disinfecting water circuit 1 as a function of the size of the buffer 6 and the storage volume 7 such that all of the legionella microbes are killed in the process water leaving the buffer 6 via the process-water output line 9 in the direction towards the circulating water circuit 2.

According to Figure 3, in the process-water collection line 15 in the flow direction before the non-return valve 16 and the water quantity limiter 17 there is a circulating distributing valve 33, whose first path 33a and whose second path 33b are connected to the process-water collection /7
line 15, wherein its third path 33c is connected via a first bypass line 34 to the process-water distributing line 11 at the tap points 12. This circulating water distributing valve 33 is regulated either as a function of the disinfecting temperature in the disinfecting water circuit 1 by a

temperature sensor 35 arranged between the loading pump 4 and the storage volume 7 in the connecting line 30 or is regulated as a function of time by means of a clock 36. This regulation is realized in that the total circulating water quantity or only a partial quantity of this water is released from the circulating water circuit 2 to the first heat exchanger 10 only when the disinfecting water circuit 1 including the process-water storage device 5 has been completely heated and thus the loading output is largely available for the circulating quantity. The remaining total circulating water or partial quantity must flow via the first bypass line 34 into the process-water distributing line 11 at the tap points 12.

The other embodiment according to Figure 4 differs from that according to Figure 3 in that the circulating water distributing valve 33 is connected hydromechanically with its third path 33c via a second bypass line 37 and a first circulating water quantity regulating valve 38 to a heating coil 39, which is arranged in the boundary 40 between the buffer volume 6 and storage volume 7 in the reaction container 5. Here, the regulation of the circulating water distributing valve 33 is realized either via the temperature sensor 35 or the clock 36, such that the total circulating water quantity is released from the circulating water circuit 2 to the first heat exchanger 10 or can be transported via the second bypass line 37 into the heating coil 39. Therefore, the loading output (disinfecting output) is always totally available for removal for heating the process-water storage device 5. In this embodiment, the loading pump 4 can be switched either by a sensor 41 in the connecting line 30 and/or by a sensor 42 in the process-water output line 9 and/or by a sensor 69, in order to meet the requirements of the process-water priority switch prescribed in the residential building. The first circulating water quantity regulating valve 38 is composed of a three-path mixing valve, whose first path 38a is connected to the second bypass line 37, whose second path 38b is connected to the entrance of the heating coil 39 in the process-water storage device 5, and whose third path 38c is connected to the process-water output line 9.

The system according to Figure 5 differs from the system according to Figure 4 essentially by the following changes:

First, the circulating water circuit 2 is provided in several parallel circulating water circuits 2a, 2b, and 2c with different circulating pumps 14a, 14b, and 14c and separate water quantity limiters 43a, 43b, and 43c.

Furthermore, the disinfecting water circuit 1 includes two separate water heaters 3a and 3b, with separate heating medium regulating valves 27a, 27b in separate heating medium lines 26a, 26b, and also with separate loading pumps 4a and 4b, which are connected in parallel. In addition, a buffer 6a is connected via the connecting line 29 before the reaction container 5 according to Figure 4 and several storage volumes 7a and 7b are connected after the storage volume 7 via the connecting line 30 and two other connecting lines 44, 46.

As can be seen from Figure 5, the buffer volume 6, 6a can leave the disinfecting water circuit 1 only via the connecting line 45 when the water flowing into the process-water output line 9 has been exposed to the necessary disinfecting temperature and the necessary disinfecting time. The same applies also for the storage volumes 7a and 7b, which connect via the connecting line 46 to the storage volume 7 in the reaction container 5. Through these two additional process-water storage devices 7a and 7b, via the lines 30, 44, and 46, the disinfecting water circuit 1 has been enlarged relative to the embodiment of Figure 4. In the two embodiments of Figures 4 and 5, the first circulating water quantity regulating valve 38 is regulated as a function of a temperature sensor 47 in the process-water output line 9 from the reaction container 5.

It is understood that the loading pump 4 or the loading pumps 4a, 4b can be switched as in the illustrated case of Figure 4 each as a function of temperature sensors 41, 42 in the connecting line 30 and/or the process-water output line 9 and/or the other temperature sensors 69, 82 in the process-water storage device 5 and in a heating medium line 26 of the water heater 3.

The other embodiment of Figure 6 differs from the system according to Figure 5 essentially in that in the disinfecting water circuit 1 there are two reaction containers 5a and 5b with separate first circulating water quantity regulating valves 38a and 38b. Each of the reaction containers 5a and 5b includes in its top part a reaction volume 6a, 6b as a buffer and in its bottom part a storage volume 7a, 7b, which is enlarged by the downstream process-water storage device 7c.

In Figures 7 and 8, the process-water distributing line 11 with the circulating pump 14 /8
and the process-water collection line 15 each form a distributing circuit 48, from which one or more stub lines 49, 50, 51, 52 branch off to secondary distributing devices 53 to 56. In this way, the first stub line 49 leads to individual removal points 12, which are provided with electrical companion heaters 57.

Furthermore, from the distributing circuit 48, a second stub line 50 leads to a secondary distributing device 54 composed of a secondary distributing line 58 at tap points 12, a circulating pump 59, a UV emitter 60, and a heat exchanger 61, with high circulating output, whose circulating water heat losses can be compensated by the heat exchanger 61 and also by a hot-water distributing valve 62 from the distributing circuit 48.

According to Figure 8, from the distributing circuit 48, two other stub lines 51, 52 lead to several closed secondary distributing circuits 68, which are provided with tap points 12, which are each composed of a circulating pump 63, 64, a circulating line 65, and a heat exchanger 66, and which are connected via the heat exchanger 66 to a secondary disinfecting water circuit 71 composed of a water heater 67 and a reaction container 70. In this circuit, the circulating pumps 63, 64 are the same as the loading pumps. Here, before the entry of the circulating line 65 into the heat exchanger 66 in the secondary distributing device 56 there is another circulating water regulating valve 72, which can be regulated as a function of a temperature sensor 73.

According to an advantageous refinement of the invention, the circulating water regulating valve 72 is formed as a three-path valve, which can be controlled by a clock 93 and the temperature sensor 73 and whose first path 72a is connected to the circulating line 65, whose second path 72b is connected to the fourth heat exchanger 66, and whose third path 72c is connected via a connecting line 90 to a connecting line 91 leading from the fourth heat exchanger 66 to the stub line 52, behind whose connecting point 92 in the flow direction (see arrows) the temperature sensor 73 is arranged. In this embodiment, advantageously in normal operation during the day, the valve 72 can allow, as a function of the temperature sensor 73 via the path 72b, only as much circulating water to flow through the connecting line 94 into the disinfecting circuit 66, 67, 71, 70 as is required at the connecting point 92 of the lines 90, 91 for guaranteeing the desired temperature at the temperature sensor 73. In contrast, during night-time hours outside of normal operating times, in a time that can be adjusted by the clock 93, the total circulating water quantity via the connecting line 94 into the disinfecting circuit 66, 67, 71, 70 is controlled by means of the circulating water regulating valve 72 and in this way the total quantity during this time is reliably disinfected until the normal operation is triggered again either by the clock 93 or by a maximum forward temperature at the tap points 12 set at the temperature sensor 73. Such a setting of the maximum temperature lying higher than the desired temperature enables on one hand a periodic reduction of microbes possibly adhered to the inner tube surfaces of the secondary distributing circuit 52-12 and an economical design of the fourth heat exchanger 66, because especially for large circulating water quantities, the difference between the inlet temperature into the distributing circuit 52, 12, 64, 72, 92, 90 and the return temperature at the first path 72a in to the circulating water regulating valve 72 can be very small. Therefore, the water quantity from the connecting line 94 into the fourth heat exchanger 66 with a temperature of, e.g., 45°C, and the hot-water quantity from the line 95 into the fourth heat exchanger 66 of, e.g., 70°C can be cooled for an efficient design only to ca. 50°C to 55°C and therefore a slowly rising temperature in the distributing circuit 52, 12, 64, 72, 90, 92 up to an adjustable maximum temperature can be generated.

Furthermore, through the installation of an electrically heated water heater 96 arranged after the water heater with control by a sensor 97, the temperature in the connecting line 71 for a temperature supply of the heating medium that is too low at the water heater 67 can be raised to the temperature level necessary for killing the microbes.

The embodiment according to Figure 9 for the 2nd solution alternative differs from the 1st solution alternative according to Figure 1 essentially in that now the first heat exchanger 10 is connected in a known way via a forward connecting line 74 and a second heat exchanger 75 to the process-water distributing line 11 at the tap points 12, via a circulating line 13 to the circulating pump 14, and via a process-water collection line 15, via a non-return valve 16, a water-quantity limiter 17, and also via the second heat exchanger 75, a return connecting line 76, and via an access

line 23 to the process-water storage device 5 and the buffer 6 into a complete circuit 1, 2. Furthermore, in contrast to Figure 1, the cold-water supply line 18 is connected in the same flow as the first heat exchanger 10 to the process-water output line 9. The cold-water preheated in the first heat exchanger 10 leaves this exchanger via a connecting line 77 to the access line 23. The essential difference of the embodiment of Figure 9 involves the appearance of a second heat /9 exchanger 75 and the elimination of the cold-water quantity regulating valve 20 of Figure 1, which comes into question especially for smaller systems with lower requirements on the consistency and level of the outlet temperature.

In Figure 10, relative to Figure 9, a cold-water quantity regulating valve 20 is arranged in the cold-water supply line 18 and a second circulating water quantity regulating valve 78 is arranged in the process-water collection line 15 in the flow direction after the water quantity limiter 17. With the two regulating valves 20, 78, both the cold-water quantity and also the circulating water quantity and thus the hot-water output temperature can be selected and regulated. In this way, the cold-water quantity regulating valve 20 is controlled by the temperature sensor 24 in the process-water distributing line 11 and the circulating water quantity regulating valve 78 is controlled by a temperature sensor 79, which is also arranged in the process-water distributing line 11. This system distinguishes itself not only by an extremely varied regulation ability through the two regulating valves 20 and 78, but also presents the ability for one of the two regulating valves 20, 78 to take over the function of the other valve, at least partially, if one of the valves fails.

The embodiment of Figure 11 results essentially from a combination of the embodiment of Figure 10 in connection with the circulating water quantity distributing valve 33 of Figure 3. In this way, in the first heat exchanger 10 the cold-water supply line 18 is connected with the same flow to the process-water output line 9 and in the second heat exchanger 75 the forward connecting line 74 is connected in the opposite flow to the process-water collection line 15. In addition, the cold-water quantity regulating valve 20 is arranged with its first path 20a and its second path 20b in the cold-water supply line 18; but in contrast, with its third path 20c connected via a connecting line 79 as a bypass to the connecting line 77. Furthermore, the circulating water quantity regulating valve 78 is arranged with its first path 78a and its second path 78b in the process water collection line 15, in contrast with its third path 78c connected via a connection line 80 as a bypass to the return connecting line 76. The circulating water quantity regulating valve 78 is regulated by a sensor 81 in the process-water distributing line 11, which, however, is attached behind the connection of the line 34 to the line 11. The circulating water distributing valve 33 is regulated as in the embodiment of Figure 3 either by means of the sensor 35 or the clock 36.

The embodiment of Figure 12 corresponds essentially to the embodiment of Figure 11, but without the circulating water distributing valve 33. Furthermore, now in the heating medium circuit 86 of the water heater 3 there is a heating medium pump 83, which can be regulated in

common or separate from the loading pump 4 and the circulating pump 14 by means of the temperature sensor 84 in the connecting line 30 and/or the temperature sensor 85 in the process-water storage device 5 and/or the temperature sensor 82 in the forward direction of the heating medium circuit 86. Through this interconnected switching acting on the loading pump 4, the heating medium pump 83, and the circulating pump 14, the requirements for the process-water priority switching are satisfied by the temperature sensors 82, 84, and 85.

The other embodiment according to Figure 13 is composed essentially from a combination of the embodiments of Figures 11 and 6. Consequently, matching parts are labeled with the same reference symbols, without their function being discussed again. In the embodiment of Figure 13, the circulating water distributing valve 33 is connected via a second bypass line 37 to the two parallel reaction containers 5a, 5b. Likewise, in the circulating water circuit 2, a total of three separate circulating water circuits 2a, 2b, and 2c are arranged in parallel.

The first heat exchanger 10 is connected to the second heat exchanger 75 and to each other also via the cold-water quantity regulating valve 20 and the second circulating water quantity regulating valve 78 according to Figure 11. This embodiment is also suitable especially for large systems with high requirements on the operating reliability, and also with circulating water quantities, e.g., three separate circulating water circuits 2a, 2b, 2c with different circulating quantities or pressure levels.

The embodiment of Figure 14 is produced essentially from a combination of the system according to Figures 2, 3, and 12, wherein now the first and second heat exchangers 10, 75 are combined into a compact heat exchanger 10 similar to Figure 2, which is assembled from a total of three sub-heat exchangers 10a, 10b, 10c. The circulating distributing valve 33 is arranged as in Figure 3 in the process-water collection line 15 and connected via the first bypass line 34 to the process-water distributing line 11. The first sub-heat exchanger 10a is connected with its input and output to the process-water output line 9.

The cold-water supply line 18 leads from the safety control valve 19 via the cold-water /10
quantity regulating valve 20 to the inlet into the sub-heat exchanger 10b, whose outlet is connected via the connecting line 89 similar to the connecting line 77 according to Figure 13 to the access line 23.

The circulating water quantity regulating valve 78 is arranged with its two paths 78a and 78b in the process-water collection line 15 and is connected with its third path 78c via the line 87 to the inlet of the sub-heat exchanger 10a, from which this line is connected via the connecting line 88 to the access line 23 for the process-water storage device 5. With reference to the sub-heat exchanger 10a, the sub-heat exchanger 10b is connected with the same flow and the sub-heat exchanger 10c is connected with the opposite flow. Both the cold-water quantity regulating valve 20 and also the second circulating water quantity regulating valve 78 are regulated by the two

temperature sensors 24 and 81, which are arranged in the process-water distributing line 11. The circulating water distributing valve 33 is regulated as in Figure 11 selectively either by the temperature sensor 35 in the connecting line 30 or by a clock 36. The process-water storage device 8 is arranged after the process-water storage device 5.

Because the embodiments of Figures 2 and 14 each have a compact heat exchanger 10, which is assembled from a total of three sub-heat exchangers 10a, 10b, 10c and which can both be viewed only as the first 10 or only as the second 75 or also as a combination of the first and second heat exchanger 10, 75, the embodiments of Figures 2 and 14 in a certain way represent a combination embodiment between the two solution alternatives of the associated Claims 1 and 2.

This also applies for the other embodiments of Figures 15 and 16.

Thus, in Figure 15 the circuit of the compact heat exchanger 10 is arranged with reference to the cold-water quantity regulating valve 20 and the second circulating water quantity regulating valve 78 is arranged according to Figure 14, wherein the circulating water distributing valve 33 of Figure 14 is eliminated. Furthermore, as in Figure 12 in the heating medium circuit 86, there is now a heating medium pump 83, which can be switched like the loading pump 4 and the circulating water pump 14 by the sensors 82, 84, 85.

The embodiment of Figure 16 is composed essentially from a combination of the embodiments of Figure 15 with the embodiment of Figure 5, wherein with these figures, matching parts are also labeled here with the same reference symbols. The embodiment according to Figure 16 contains the same compact heat exchanger 10 with the cold-water quantity regulating valve 20 and the second circulating water quantity regulating valve 78 according to Figure 15, wherein the circulating water distributing valve 33 with the second bypass line 37 to the reaction container 5 is also arranged in the process-water collection line 15. According to Figure 5, a buffer 6a is arranged before this reaction container 5 and two storage volumes 7a, 7b are arranged after this container. This embodiment distinguishes itself by a large buffer and storage capacity, by several parallel circulating water circuits 2a, 2b, 2c, and also by the compact heat exchanger 10 with its many regulating possibilities. This embodiment is also suitable for large systems with both large circulating water and also disinfecting water circulating quantities. The activation and deactivation possibilities both for the circulating water circuits 2a, 2b, 2c and also for the storage volumes 7a and 7b and the upstream buffer 6a in the disinfecting water circuit 1 guarantee an extremely energy-efficient and flexible operation also like the parallel loading pumps 4a and 4b with the parallel water heaters 3a and 3b.

It is understood that additional combination possibilities exist between the embodiments of Figures 1 to 16, which [possibilities], however, do not leave the principle of the invention according to the associated Claims 1 and 2.

List of reference symbols		/11
Disinfecting water circuit	1	
Circulating water circuits	2, 2a, 2b, 2c	
Water heater	3, 3a, 3b, 67	
Loading pump	4, 4a, 4b	
Process-water storage device or reaction container	5, 8, 5a, 5b	
Buffer	6, 6a, 70	
Storage volume	7, 7a, 7b, 7c	
Process-water output line	9	
Heat exchanger	10, 61, 66, 75	
Sub-heat exchanger	10a, 10b, 10c	
Process-water distributing line	11	
Tap points	12	/12
Circulating line	13	
Circulating pumps	14, 59, 63, 64	
Process-water collection line	15	
Non-return valve	16	
Water quantity limiter	17	
Cold-water supply line	18	
Safety control valve	19	
Cold-water quantity regulating valve	20	
Paths of the cold-water quantity regulating valve 20	20a, 20b, 20c	
Intermediate line	21	
Connecting lines	22, 29, 30, 44, 45, 46, 77, 79, 80, 87, 88, 89	
Access line	23	
Temperature sensor	24, 25, 28, 31, 35, 41, 42, 47, 69, 73, 79, 81, 82, 84, 85, 86	/13
Heating medium line	26	
Heating medium regulating valve	27	
Water quantity regulating valve	32	
Circulating water distributing valve	33	
Paths of the circulating water distributing valve	33a, 33b, 33c	
First bypass line	34	
Clock	36	
Second bypass line	38	

Paths of the first circulating water quantity regulating valve	38a, 38b, 38c
Heating coil	39
Boundary	40
Water-quantity limiter	43a, 43b, 43c
Distributing circuit	48
Stub lines	49, 50, 51, 52
Distributing devices	53, 54, 55, 56
Companion heater	57
Distributing line	58
UV emitter	60
Hot-water distributing valve	62
Circulating line	65
Secondary distributing circuit	68
Secondary disinfecting water circuit	71
Forward connecting line	74
Return connecting line	76
Second circulating water quantity regulating valve	78
Paths of the circulating water quantity regulating valve	78a, 78b, 78c
Heating medium pump	83
Heating medium circuit	86

/14

Claims /15

1. System for heating process water and for killing legionella in this process water with a cold-water supply line to a first heat exchanger for preheating the supplied cold water and for cooling the process water fed via a process-water output line from a disinfecting water circuit, which is heated to a disinfecting temperature and which is composed of a water heater, a loading pump, a process-water storage device, and a buffer, wherein in the feed direction of the process water, the buffer connects via the process-water output line to the first heat exchanger and from this to the process-water distributing line at the tap points and via a circulating line to the circulating pump, characterized in that the process water distributing line (11) is connected via a process-water collection line (15), via a non-return valve (16), a water-quantity limiter (17), the cold-water supply line (18), and also via an access line (23) to the loading pump (4) via the water heater (3) and the buffer (6) into a complete circuit (1, 2).

2. System for heating process water and for killing legionella in this process water with a cold-water supply line to a first heat exchanger for preheating the supplied cold water and for cooling the process water fed via a process-water output line from a disinfecting water circuit,

which is heated to a disinfecting temperature and which is composed of a water heater, a loading pump, a process-water storage device, and a buffer, wherein in the transport direction of the process water, the buffer is connected via the process-water output line to the first heat exchanger and from this to a process-water distributing line at tap points and via a circulating line to the circulating pump, characterized in that the first heat exchanger (1) is connected in a known way via a forward connecting line (74) and a second heat exchanger (75) to the process-water distributing line (11) at the tap points (12), via a process-water collection line (15), via a non-return valve (16), a water quantity limiter (17), and also via the second heat exchanger (75), a return connecting line (76), and via an access line (23) to the loading pump (4) via the water heater (3) and the buffer (6) into a complete circuit (1, 2).

3. System according to Claim 1 or 2, characterized in that for tap inactivity, the output of the loading pump (4) above the output of the circulating pump (14) draws the storage volume (7) in the process-water storage device (5) via a connecting line (30) and always heats it back to the disinfecting temperature back in the disinfecting water circuit (1).

4. System according to one of Claims 1 to 3, characterized in that the process water storage device (5) is formed in a known way the same as the reaction container (5), in whose upper part a reaction volume (6) is located as a buffer (6) and in whose bottom part the storage volume (7) is located.

5. System according to one of Claims 1 to 4, characterized in that the buffer (6) in the process-water storage device (5) is enlarged by one or more upstream buffers (6, 6a) and/or the storage volume (7) is enlarged by one or more hot-water storage devices (5, 7a, 7b, 7c, 8) arranged after the loading pump (4, 4a, 4b) in the flow direction.

6. System according to one of Claims 1 to 5, characterized in that in the disinfecting water circuit (1), there are several loading pumps (4a, 4b) allocated either to a common water heater (3) in parallel or each to an individual water heater (3a, 3b).

7. System according to one of Claims 1 to 6, characterized in that in the disinfecting water circuit (1), there are several parallel loading pumps (4a, 4b) allocated to one or more reaction container(s) (5, 5a, 5b) connected one behind the other or each acts on an individual parallel reaction container (5a, 5b).

8. System according to Claim 1 and 3 to 7, characterized in that in the cold-water supply line (18) to the first heat exchanger (10), there is a cold-water quantity regulating valve (20), whose second path (20b) is connected via an intermediate line (21) to the first heat exchanger (10) and from this (10) via a connecting line (22) as the third path (20c) to the access line (23) to the process-water storage device (5). /16

9. System according to Claim 8, characterized in that the cold-water quantity regulating valve (20) can be controlled by a temperature sensor (24), which is arranged in the process-water distributing line (11) at the tap points (12).

10. System according to one of Claims 1 to 9 to 12, characterized in that in the cold-water supply line (18) before the cold-water quantity regulating valve (20) in the flow direction, there is a safety control valve (19), which can be throttled or closed by a temperature sensor (25) in the reaction container (5) in the vicinity of the process-water output line (9), if in the disinfecting water circuit (1) the temperature of the storage volume (7) in the reaction container (5) falls below the lowest permissible disinfecting temperature.

11. System according to one of Claims 1 to 10, characterized in that in the flow direction before the water quantity limiter (17) and the non-return valve (16) in the process-water collection line (15) there is a circulating water distributing valve (33), whose third path (33c) is connected either via a first bypass line (34) to the process-water distributing line (11) at the tap points (12) or via a second bypass line (37) and via a first circulating water quantity regulating valve (38) to a heating coil (39), which is arranged in the boundary (40) between the reaction volume (6) and the storage volumes (7) in the reaction container (5).

12. System according to Claim 11, characterized in that the circulating water distributing valve (33) can be regulated either as a function of the disinfecting temperature in the disinfecting water circuit (1) by a temperature sensor (35) arranged between the loading pump (4) and storage volume (7) or as a function of the time by means of a clock (36), such that the total circulating water quantity or only a portion of this water quantity is released from the circulating water circuit (2) to the first heat exchanger (10) and the remaining total or partial circulating water quantity can be fed either via the first bypass line (34) in the process-water distributing line (11) at the tap points (12) or via the second bypass line (37) in the heating coil (39).

13. System according to one of Claims 1 and 3 to 13, characterized in that the first circulating water quantity regulating valve (38) in the second bypass line (37) can be regulated as a function of a temperature sensor (47) in the process-water output line (9) for the reaction container (5).

14. System according to one of Claims 1 to 13, characterized in that the loading pump (4), the circulating pump (14), and a heating medium pump (83) can be connected as a function of temperature sensors (41, 42, 69, 82, 84, 85) to the process-water output line (9), to the process-water storage device (5), to the connecting line (30), and to a heating medium line (26) of the water heater (3).

15. System according to one of Claims 2 to 14 and 16 to 18, characterized in that in the process-water collection line (15) before the second heat exchanger (75) in the flow direction there is a second circulating water quantity regulating valve (78), whose first path (78a) is connected to

the water quantity limiter (17), whose second path (78b) is connected to the second heat exchanger (75), and whose third path (78c) is connected to the return connecting line (76).

16. System according to Claim 15, characterized in that the second circulating water quantity regulating valve (78) can be regulated by a temperature sensor (79, 81) in the process-water distributing line (11) at the tap points (12).

17. System according to one of Claims 1 to 16, characterized in that the first heat exchanger (10) can be charged by the process-water output line (9) and the cold-water line (18) either in the same flow or in the opposite flow [direction].

18. System according to one of Claims 1 to 17, characterized in that several process-water distributing lines (11) and process-water collection lines (15) each with separate tap points (12) and circulating pumps (14a, 14b, 14c) are connected in parallel to separate circulating water circuits (2a, 2b, 2c). /17

19. System according to one of Claims 1 to 18, characterized in that the first and second heat exchangers (10, 75) can be integrated into a compact device by themselves or together with the heat exchanger or exchangers (3, 3a, 3b) and loading pumps (4, 4a, 4b) and also with one or more reaction containers (5a, 5b) of the disinfecting circuit (1).

20. System according to one of Claims 1 to 19, characterized in that the first and/or the second heat exchanger (10, 75) is composed of a total of three compactly assembled sub-heat exchangers (10a, 10b, 10c), of which the first (10a) is connected at its input to the process-water output line (9) and at its output to the process-water distributing line (11), the second (10b) is connected at its input to the cold-water supply line (18) and at its output to the access line (23) to the process-water storage device (5), and the third sub-heat exchanger (10c) is connected with its input to the process-water collection line (15) and with its output to the access line (23) to the process-water storage device (5).

21. System according to Claim 20, characterized in that between the second circulating water quantity regulating valve (78) is arranged between the water quantity limiter (17) and the inlet to the third sub-heat exchanger (10c) with its first (78a) and third path (78c), while the second path (78b) is connected to the access line (23).

22. System according to one of Claims 1 to 21, characterized in that the process-water distributing line (11) forms a distributing circuit (48), from which one or more stub lines (49 to 52) branch off to secondary distributing devices (53 to 56), with the circulating pump (14) and the process-water collection line (15).

23. System according to Claim 22, characterized in that at least one first stub line (49), which, provided with electrical companion heaters (57), leads to individual removal points (12), branches off from the distributing circuit (48).

24. System according to Claim 22, characterized in that from the distributing circuit (48), at least one second stub line (50) leads to a secondary distributing device (54) with high circulating output, which is composed of a secondary distributing line (59) at tap points (12), a circulating pump (59), a UV emitter (60), and a third heat exchanger (61) and whose circulating heat losses can be compensated by the third heat exchanger (61) and also by a hot-water distributing valve (62) from the distributing circuit (48).

25. System according to Claim 22, characterized in that from the distributing circuit (48), one or more stub lines (51, 52) lead to one or more closed secondary distributing circuits (68), which are provided with tap points (12), which are each composed of a circulating pump (63, 64), a circulating line (65), and a fourth heat exchanger (66), and which is connected via the fourth heat exchanger (66) to a secondary disinfecting water circuit (71), which is composed of a water heater (67) and a reaction container (70) and in which the circulating pump (63, 64) is the same as the loading pump.

26. System according to Claim 25, characterized in that before the inlet of the circulating line (65) into the fourth heat exchanger (66) there is another circulating water regulating valve (72), which can be regulated as a function of a temperature sensor (73).

27. System according to Claim 25 and 26, characterized in that the circulating water regulating valve (72) is formed as a three-path valve, which can be controlled by a clock (93) and the temperature sensor (73) and whose first path (72a) is connected to the circulating line (65), whose second path (72b) is connected to the fourth heat exchanger (66), and whose third path (72c) is connected via a connecting line (90) to a connecting line (91) leading from the fourth heat exchanger (66) to the stub line (52), behind which connecting point (92) in the flow direction the temperature sensor (73) is arranged.

28. System according to Claims 25 to 27, characterized in that inadequate rising /18
temperature level of the heating medium, a water heater (96) and its temperature sensor (97) are connected after the water heater (67).

[No figures provided.]